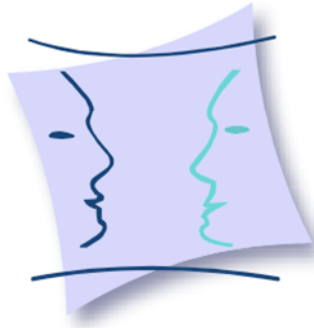




Technische Universität Darmstadt



Telecooperation

Application of Subject-oriented Modeling
in Automatic Service Composition

Erwin Aitenbichler

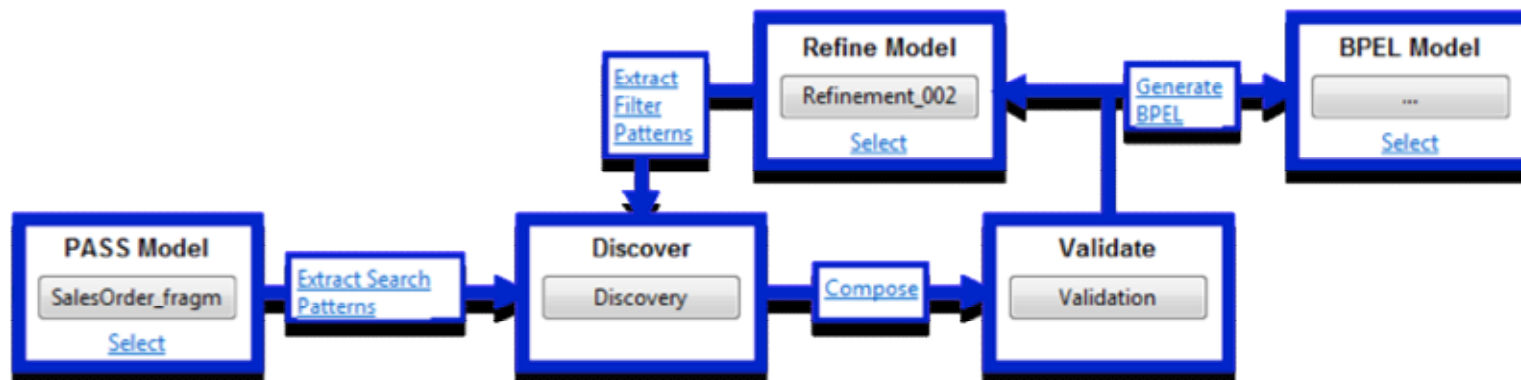
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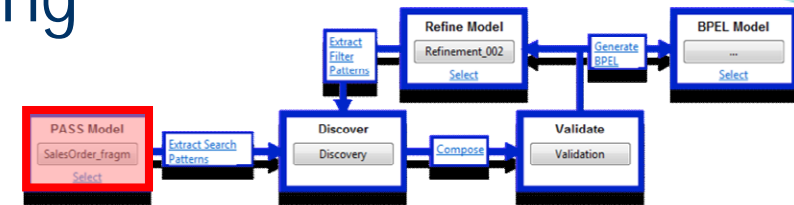


Fragmented Process Modeling

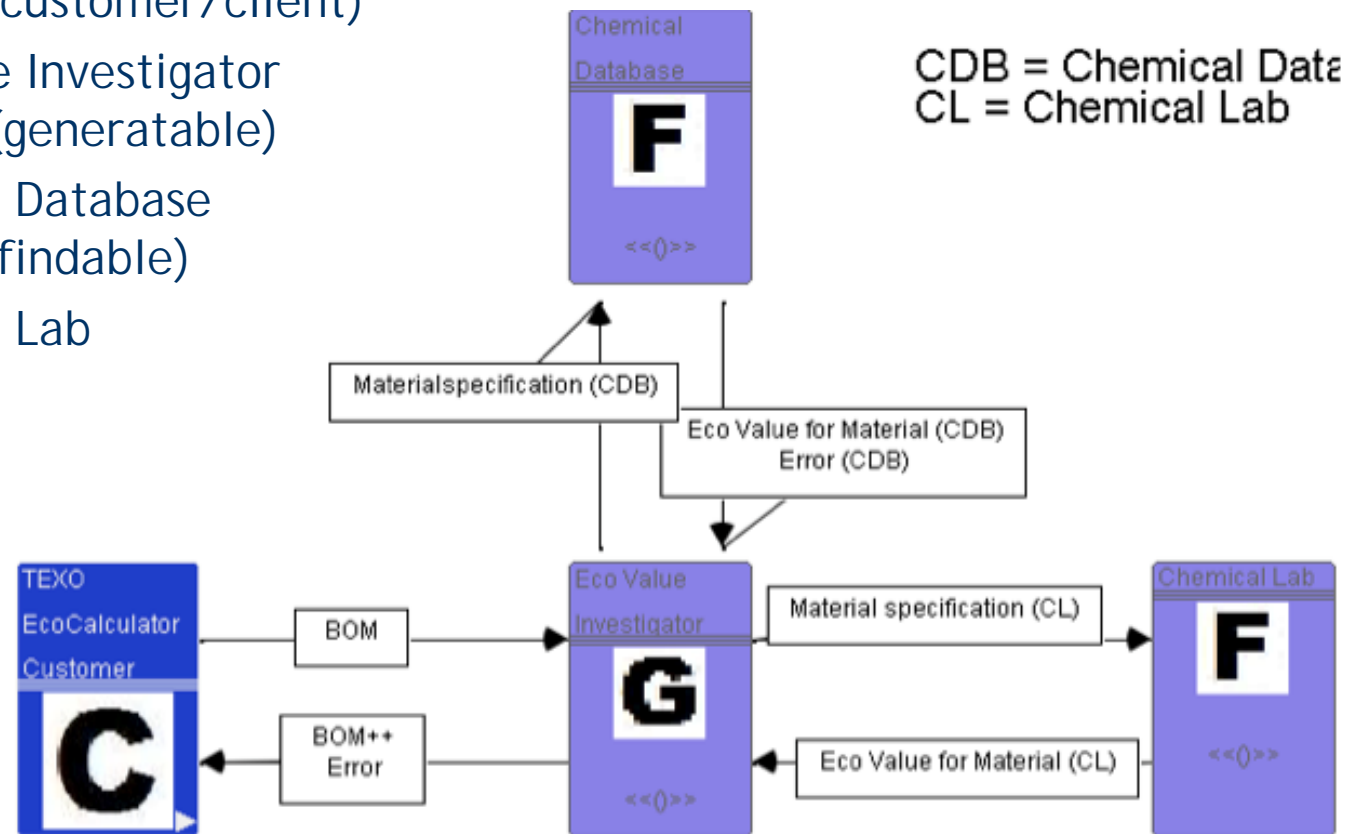
- Modeling
 - Subject-oriented modeling with fragmented process model
- Discovery
 - Search for services using process pattern matching & constraints
- Validation
 - Transformation to process calculus (CCS) and verification
- Precising
 - Inspection by user & precising of fragmented model
- Deployment
 - Deployment on Automatic Service Composition Server
 - Transformation to executable process language (e.g., BPEL)



Modeling



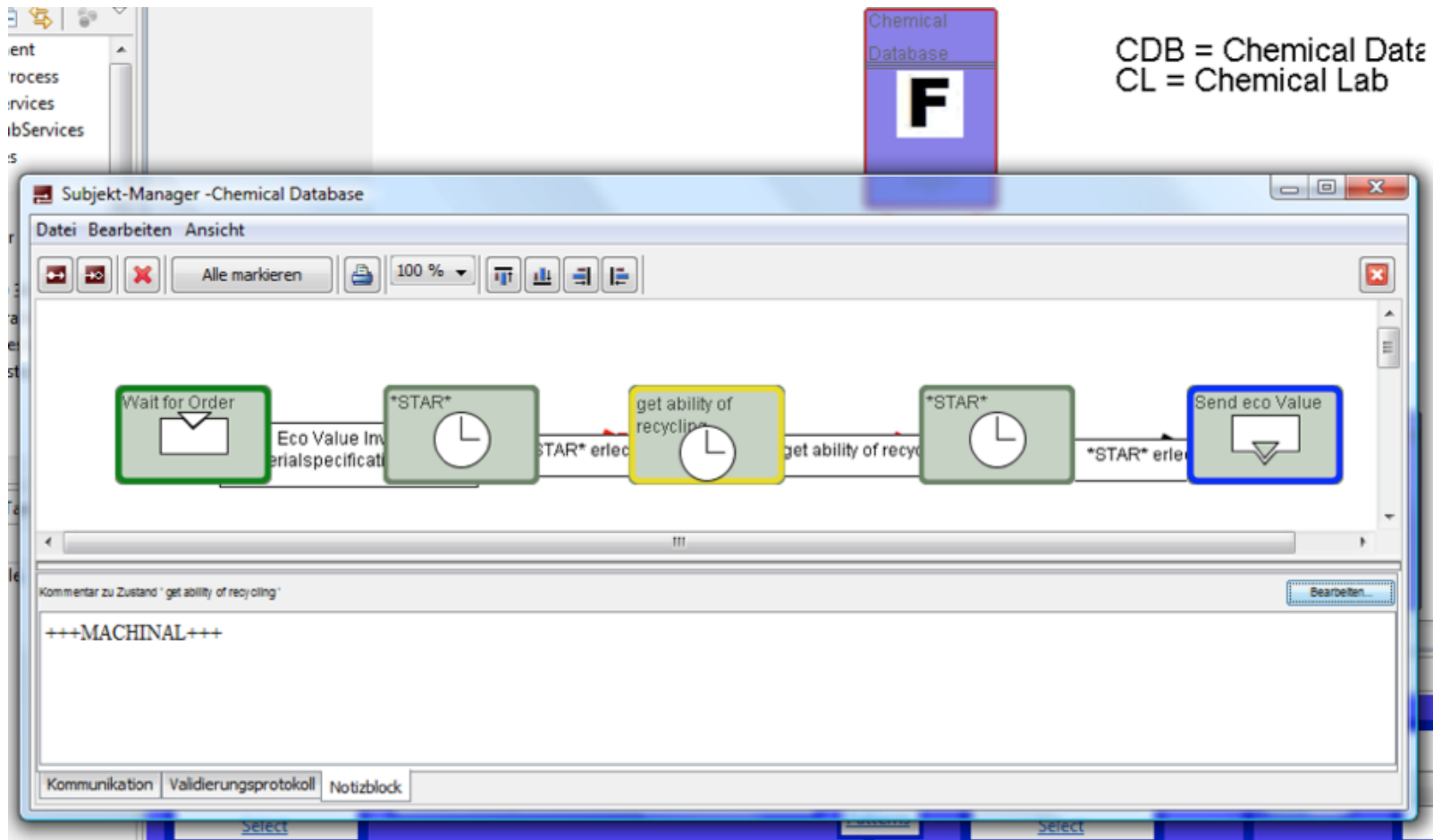
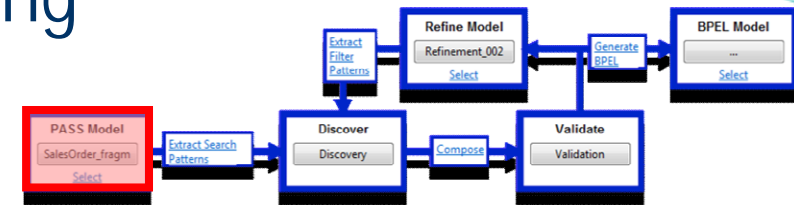
- Subject Interaction Diagram
 - TEXO Eco Calc. Customer
Type: C (customer/client)
 - Eco Value Investigator
Type: G (generatable)
 - Chemical Database
Type: F (findable)
 - Chemical Lab



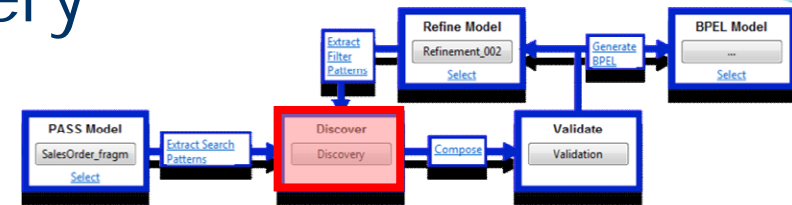
Modeling Tool: jCOM1 jPASS

Modeling

- Chemical Database
 - Findable -> Search Pattern



Discovery



- Discovery implemented on the Programmed Graph Rewriting System GRL
 - Service process descriptions -> work graph
 - Fragmented subject proc. desc. -> RDL pattern

The screenshot shows the Discovery tool interface with two main panels: **Subjects** and **Candidate Services**.

Subjects Panel:

- Search Patterns:**
 - ☒ N Indian_Chemical_fragm_00.scp
 - ☒ TEXO_EcoCalculator_Customer
 - ☒ Eco_Value_Investigator
 - ☒ Chemical_Database
 - ☒ Chemical_Lab
- Buttons:** Discover, Discover all, Refresh
- Filters:**
 - Use marked Filters
 - Use all Filters
 - Refresh

Candidate Services Panel:

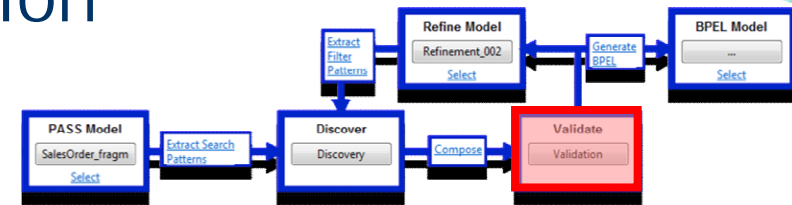
- Candidates:**
 - ☒ N Indian_Chemical_fragm_00.scp
 - ☒ Service_006.xgf
 - ☒ Service_007.xgf
 - ☒ Service_008.xgf
 - ☒ Service_010.xgf
 - ☒ Service_011.xgf
 - ☒ Service_018.xgf
 - ☒ Service_019.xgf
- Buttons:** Save, Result Saved
- File Preview:**

```

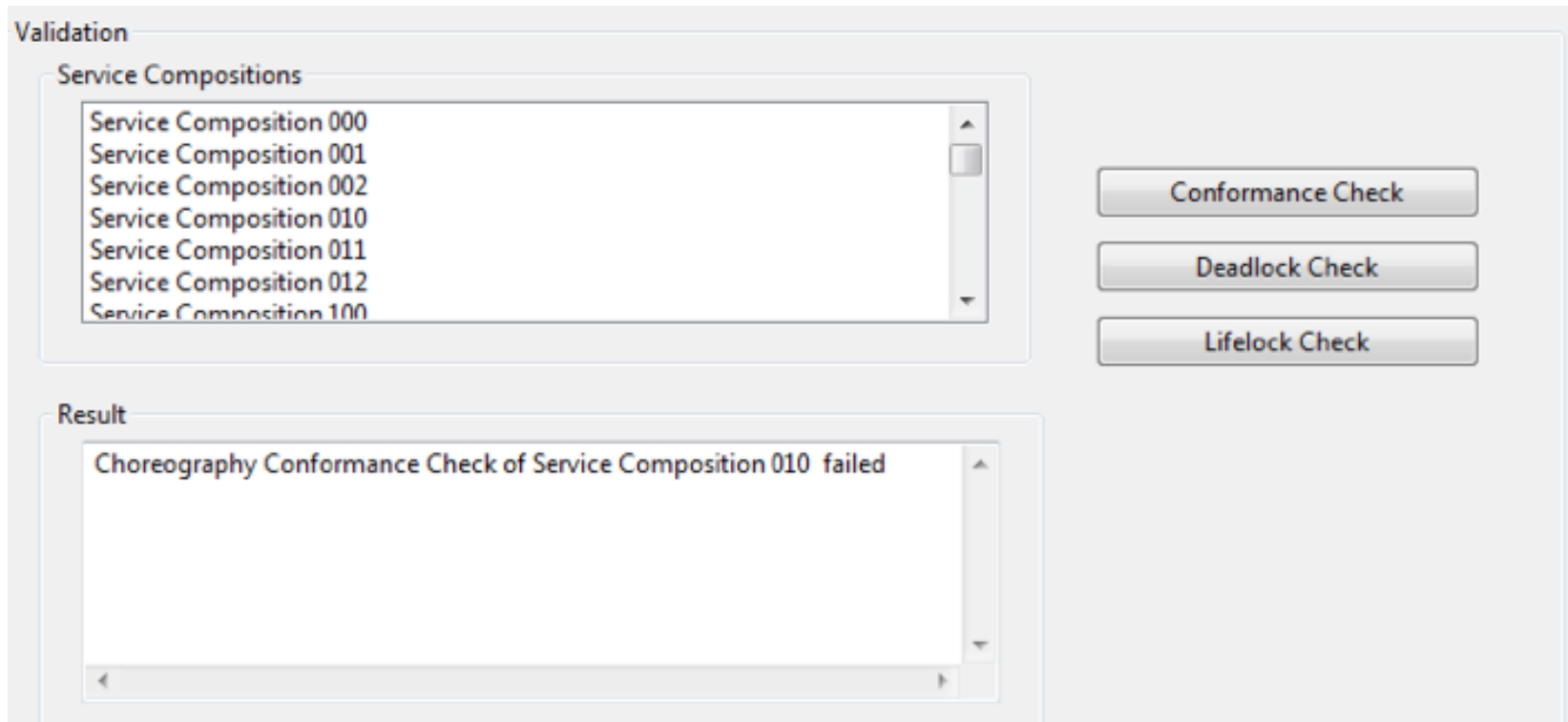
<?xml version="1.0" encoding="UTF-8"?>
<graph xmlns="http://schemas.tk.informatik.tu-darmstadt.de/TEXO/SCP1"
  <serviceKey> http://leda.tk.informatik.tu-darmstadt.de/TEXO/services/Indi
  <node name="TEXO_EcoCalculator_Customer">
    <attr key="type" value="SUBJECT"/>
    <attr key="name" value="TEXO_EcoCalculator_Customer"/>
  </node>
  <node name="Eco_Value_Investigator">
    <attr key="type" value="SUBJECT"/>
    <attr key="name" value="Eco_Value_Investigator"/>
  </node>

```

Validation

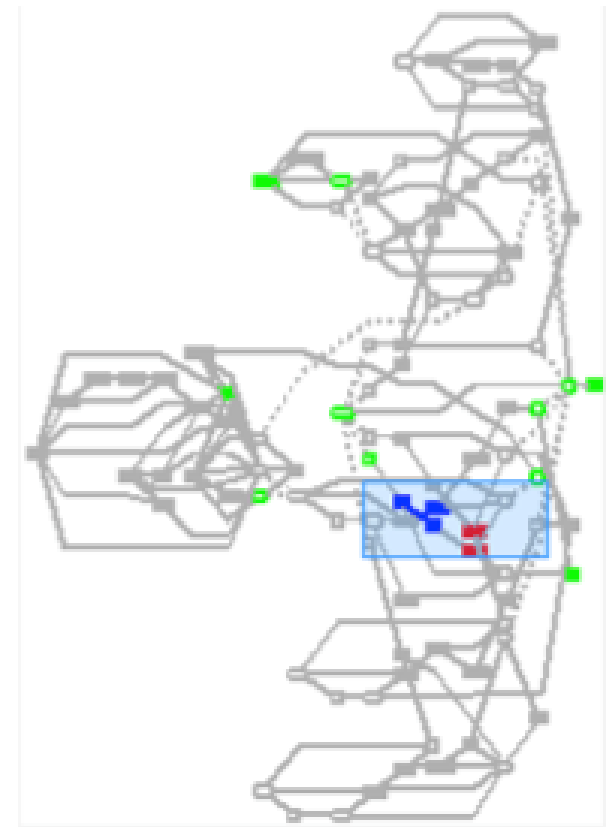
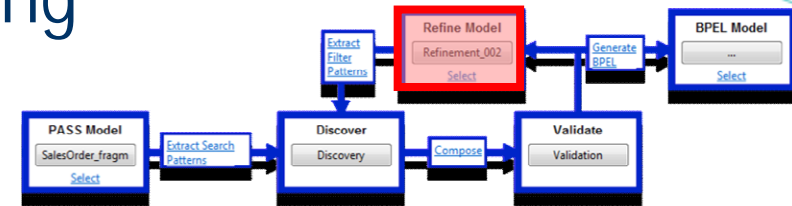


- Choreography conformance check
- Verification based on process calculus
 - CWB-NC (μ -calculus): deadlock, lifelock, fairness, 4-eye principle, etc.



Precising

- In the resulting compositions, there are potentially too many matches
- Engineer eliminates unwanted behavior in precising step
- Four annotations (colors):



required behavior:



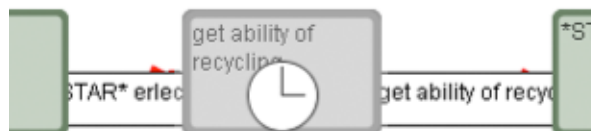
prohibited behavior:



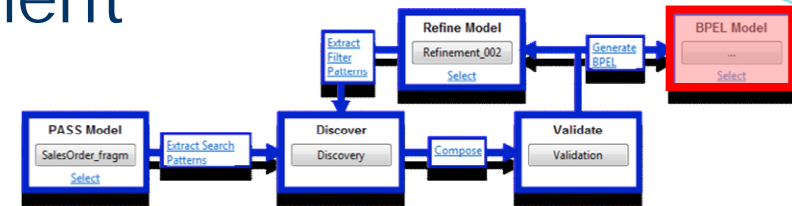
permitted behavior:



not assigned:



Deployment

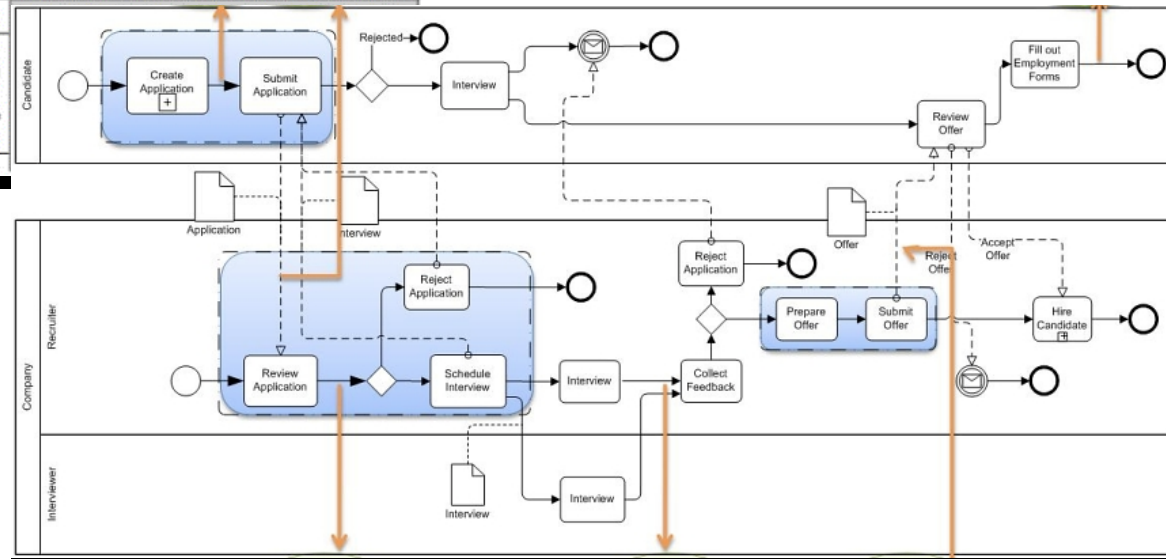


- Deployment of fragmented process on Automatic Service Composition Server
- Modeling process
 - Process model should be „minimal“
 - But precise enough to provide the desired functionality
- Process model is still „open“
 - Server can periodically look for new services and integrate them
- BPEL Generation
 - one BPEL per composition
 - or one „BPEL+“ per same subject structure
 - > adaptation component (TU Dresden)

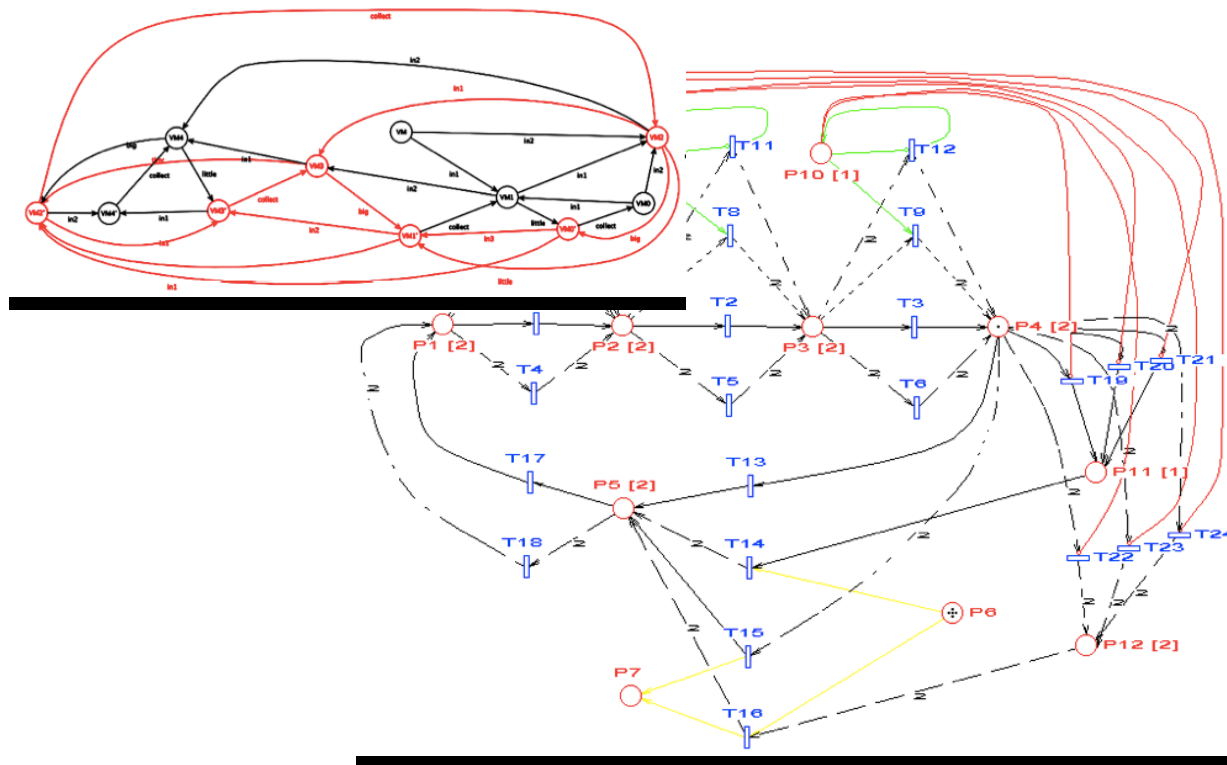
BPMN

HandsOn Modeling		Price List: September 10, 2008	Ship Date: October 25, 2008
Whiteboard Magnets for BPMN Process Modeling		(Prices and Availability subject to Change)	
Contents: Core Set		14 Unique elements	\$99.00
		Total Pieces: 88	
6"x4"	3.5" Square		
Activity Qty 25	Sub-Process Qty 15	Start Event Qty 5	Intermediate Event Qty 2
Contents: Full Set		38 Unique elements	\$199.00
		Total Pieces: 290	
6"x4"	3.5" Square		
Activity Qty 50	Sub-Process Qty 15	Sub-Process Qty 5	Looping Task Qty 5
3.5" Square (Cont'd)			
End Event Qty 10	Error Event Qty 10	Exception Event Qty 5	Complex Event Qty 5
3.5" Square (Cont'd)			
Complex Event Qty 10	Signal Event Qty 10	Timer Event Qty 10	Parallel Gateway Qty 5

- Problems:
 - lack of formal semantics
 - not verifiable
 - no projections
 - no automatic transformation to executable process



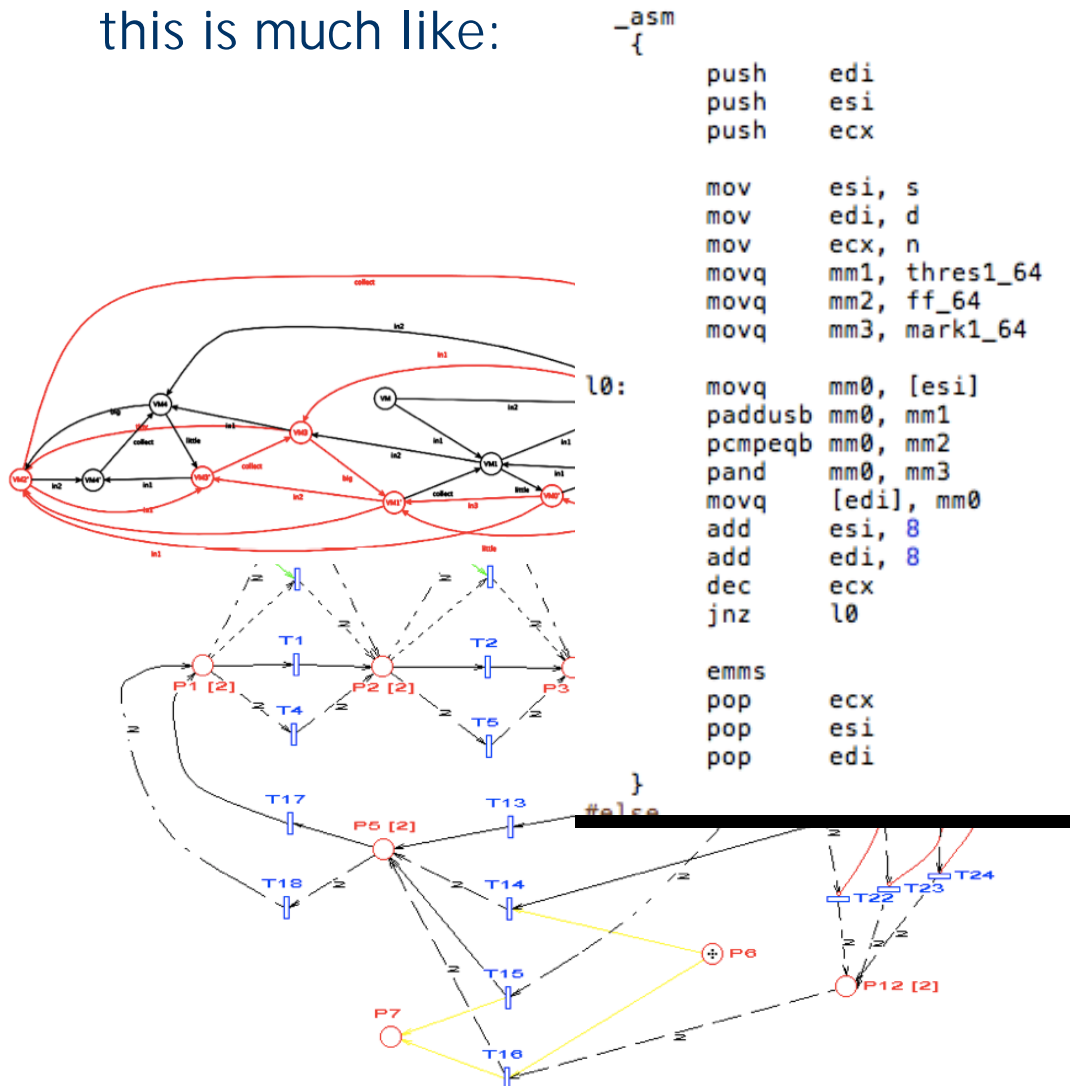
LTS and Petri Net



- Seem complex and hard to manage. Why?
Mixing of different aspects into a flat model!
 - Subjects (concurrency)
 - Embedding into business
 - Process instances
- And workflow patterns? can be reduced! [GrToe09]

LTS and Petri Net

- When compared to programming languages, this is much like:



... but there is:

- Modular programming
- Object-oriented programming
- Aspect-oriented programming

Subject-oriented Modeling

- Advantages
 - Formal semantics
 - Processes can be verified
 - Automatic projection to external behavior
 - Code generation is possible
 - Hierarchy
 - Clustering: group components; move to higher abstraction level
 - Refining: go into more detail; move to lower abstraction level
- Advantages for Service-oriented computing
 - Service = Subject
 - frameworks are different from services (programmers' perspective)
 - framework: support framework, object-oriented view
 - component: subject-oriented view
 - services are constructed using frameworks
 - Appropriate model constructs
 - No mixing of different concerns
 - semantically richer than LTS, Petri Nets, State Charts
 - note: modeling language; apart from that: all are Turing-complete
 - State Charts: no message semantics



There is a need for:

A high-level language for the
formal modeling of
business processes

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